ORIGINAL SPECIFICATION

METHOD FOR MOUNTING ELECTRONIC COMPONENT

BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION

[0001]

This invention relates to a method for mounting through an adhesive sheet an electronic component on a printed circuit board provided with a wiring pattern.

DESCRIPTION OF RELATED ART

[0002]

In implementation of a general COF (Chip on Film) mounting method, an anisotropic conductive film 14 is bonded onto a flexible board 13 formed with wiring patterns 11 corresponding to electronic component terminals and a solder resist 12 formed in a manner to surround an area to be mounted with electronic component and to cover the wiring patterns 11, as shown in Fig. 1A, while an electronic component 16 having bumps 15 is positioned and placed on the anisotropic conductive film 14, thereby being subjected to thermocompression bonding as shown in Fig. 1B. An electronic component mounting module such as shown in Fig. 1C is therefore obtained.

[0003]

In the meanwhile, in the COF mounting method as described above, air may remain between the anisotropic conductive film 14 and the flexible board 13 due to uneven surface created by the wiring pattern 11, the solder resist 12, and so on as shown in Fig. 1B. When the electronic component 16 is mounted in such a state, such problems may occur that the air trapped between the anisotropic conductive film 14 and the flexible board 13 expands due to heat and pressure added at a mounting time, thereby forming a void 17, or at worst, the void bursts to destroy the anisotropic conductive film 14, thereby resulting in exposure of the wiring pattern 18. The void 17 or exposure 18 of the wiring pattern leads to decrease in reliability of the electronic component mounting module.

[0004]

Hence, to prevent such problems as described above, a technology has been proposed in which the trapped air is released to an exterior by forming holes in a

thickness direction of the flexible board (see, e.g., Patent Literature 1, Japanese Patent Laying-Open No. H05-343844). According to Patent Literature 1, the ventilation holes are formed in a thickness direction in an area to be connected to a flexible circuit board when bonding and uniting an inflexible circuit board to the flexible circuit board through the anisotropic conductive film. With the connecting method according to Patent Literature 1, therefore, even if a bubble (air) remaining at a contact surface between the inflexible circuit board and the flexible circuit board expands due to application of heat, for example, the air bubble diffuses and outgases easily through the ventilation hole in the area to be connected to the flexible circuit board without remaining in the above described area.

[0005]

However, the above described method according to Patent Literature 1 requires a superfluous process to previously form or process the holes on the flexible board, thereby having such a problem as complicating the mounting operation. Thus, required is development of an art to solve the problem described above with a means different from the method described in Patent Literature 1.

DETAILED DESCRIPTION

[0006]

This invention has been proposed considering the current condition, and aims to provide a method for mounting an electronic component, with which reliability can be improved without complicating mounting operation.

[0007]

To achieve the above described object, the method for mounting the electronic component according to this invention, with which the electronic component is mounted through an adhesive sheet to a printed circuit board provided with a wiring pattern, is characterized in that the adhesive sheet is bonded to an area on the printed circuit board to which the electronic component is mounted, in a state where air intervening between the adhesive sheet and the printed circuit board is heated.

[0008]

With the above described method for mounting the electronic component, the expanded air is trapped between the adhesive sheet and the printed circuit board by

rendering the air intervene between the adhesive sheet and the printed circuit board in a process for bonding the adhesive sheet to the printed circuit board. The trapped air is reduced in volume by being cooled. The amount of the trapped air is substantively reduced as described above, thereby solving such problems that the trapped air expands due to application of heat at the time of thermally bonding the electric component and thus causes occurrence of the void or exposure of the wiring pattern.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

Fig. 1A is a cross-sectional view illustrating a process for bonding an anisotropic conductive film according to a conventional method for mounting an electronic component;

Fig. 1B is a cross-sectional view illustrating a process for mounting the electronic component according to a conventional method for mounting the electronic component;

Fig. 1C is a schematic plan view showing an electronic component mounting module according to a conventional method for mounting the electronic component;

Fig. 2A is a schematic plan view illustrating an example of the electronic component mounting module manufactured according to this invention;

Fig. 2B is a schematic cross-sectional view along a line A-A' in Fig. 2A;

Fig. 3A is a schematic cross-sectional view illustrating a process of a method for mounting the electronic component according to this invention in which a flexible board is manufactured;

Fig. 3B is a schematic cross-sectional view illustrating a process of a method for mounting the electronic board according to this invention in which air between the flexible board and the anisotropic conductive film is heated;

Fig. 3C is a schematic cross-sectional view illustrating a process of a method for mounting the electronic component according to this invention in which the anisotropic conductive film is bonded;

Fig. 3D is a schematic cross-sectional view illustrating a process of a method for mounting the electronic component according to this invention in which the flexible board is cooled down;

Fig. 3E is a schematic cross-sectional view illustrating a process of a method for mounting the electronic component according to this invention in which the electronic component is mounted; and

Fig. 4 is a table showing apparent conditions and void rate in alphabetical notifications A to F.

Best Mode for Carrying Out the Invention

[0010]

Hereinafter, a method for mounting an electronic component according to this invention is described in reference to drawings. Described first is an electronic component mounting module manufactured according to this invention.

[0011]

The electronic component mounting module manufactured according to this invention is structured according to a so-called COF (Chip on Film) mounting method with which a plurality of wiring patterns 2 on, e.g., a flexible board 1 defined as a printed board are joined by a pressure welding method to bumps 4 of an electronic component 3 through an anisotropic conductive film 5 defined as an adhesive sheet so that the electronic component 3 is loaded on the flexible board 1.

[0012]

On the flexible board 1, a solder resist 6 for maintaining electrical insulation performance of the mutual wiring patterns 2 as well as for protecting the wiring patterns 2 coats the wiring patterns 2 in a manner to expose a portion of the wiring patterns 2 in contact with the electronic component 3. Furthermore, the solder resist 6 has such an opening as surrounding an area to be mounted with the electronic component 3.

[0013]

The anisotropic conductive film 5 is, for example, adhesive formed in a film shape, in which conductive particles are dispersed, and maintains an electrical connection between the electronic component 3 and the flexible board 1 by welding of those with pressure. The anisotropic conductive film 5 is rendered to have such an outside dimension as overlapping with an inner circumferential edge of the solder resist 6 and to be bonded onto the solder resist 6 in a manner to coat the area to be

mounted with the electronic component 3. It is to be noted that the adhesive sheet is not limited to the above described anisotropic conductive film 5 but may be, for example, a sheet of mere adhesive not containing the conductive particles.

[0014]

Any components used for the electronic component mounting module of this type can be used as those composing the electronic component mounting module such as the above.

[0015]

As the flexible board 1, for example, an insulating substrate made of flexible polyimide can be used. The plurality of wiring patterns 2 on the flexible board 1 are made of, for example, a conductor such as, e.g., copper or the like, and formed corresponding to the bumps of the electronic component 3. It is to be noted that the printed board is also not limited to the above described flexible board 1 but may be applicable to a general wiring board such as, e.g., a so-called rigid board or the like.

[0016]

The electronic component 3 is defined as, for example, an IC chip, i.e., an IC chip such as, e.g., a semiconductor bare chip, or the like, and has a surface with the bumps 4 made of gold or the like, serving as a terminal.

[0017]

As the adhesive composing the anisotropic conductive film 5, various types of thermosetting resin, thermoplastic resin, rubber, or the like can be used. It is especially desirable to use the thermosetting resin from a view point of reliability after connection. Used as the thermosetting resin is a synthetic resin such as, e.g., an epoxy resin, a melamine resin, a phenol resin, a diallyl phthalate resin, a bismaleimide triazine resin, a polyester resin, a polyurethane resin, a phenoxy resin, a polyamide resin, a polyimide resin, or the like, or rubber or elastomer containing a functional group such as, e.g., a hydroxyl group, a carboxyl group, a vinyl group, an epoxy group, or the like. Especially, the epoxy resin can be desirably used from a viewpoint of each property. As the epoxy resin, a bispphenol type epoxy resin or an epoxy novolac resin, or an epoxy compound in which a molecule contains two or more oxirane groups can be used. It is preferable to use the high purity epoxy resin containing an impurity ion, especially a chlorine ion, of less than or equal to 50 ppm.

[0018]

Various conductive particles can be used for the anisotropic conductive film 5, such as a metal power made of, e.g., nickel, silver, copper, or alloy of those, a coated conductive particle plated with metal, in which a surface of a spherical resin particle is coated with conductive material, a particle comprising those electrical conductors and having a surface formed with an insulating resin film, which have been conventionally used for anisotropic conductive adhesive. Such conductive particles preferably have a particle diameter of 0.2 to 20 μm.

[0019]

The anisotropic conductive film 5 composed of constituent material such as above has melt viscosity preferably in a range between 1.0×105mPa·s and 1.0×107mPa·s. There is fear that the anisotropic conductive film 5 cannot have sufficient effects where having excessively high melt viscosity.

[0020]

Furthermore, any solder resists normally used for the electronic component mounting module of this type, such as, e.g., insulating resist material or the like can be used as the solder resist 6.

[0021]

Explained next is the electronic component mounting method for manufacturing the electronic component mounting module having the above described structure.

[0022]

For example, a flexible board thoroughly bonded with copper foil is first etched to prepare the flexible board 1 having the plurality of wiring patterns 2 corresponding to the bumps of the electronic component to be mounted. The solder resist 6 is formed in a manner to surround an area on the flexible board, to which the electronic component on the flexible board 1 is mounted, so as to have such an opening as exposing both one end of each wiring pattern 2, to which the vamps 4 of the wiring pattern 2 are electrically connected and one portion of an area on the flexible board 1, to which the electronic component 3 is mounted. Th e steps explained above is corresponding to Fig. 3A.

[0023]

As indicated by an arrow in Fig. 3B, air on the flexible board 1 is next heated by, for example, heating the flexible board 1. As shown in Fig. 3C, the anisotropic conductive film 5 is subsequently bonded, in a state where the heated air intervenes, to the area on the flexible board to which the electronic component is mounted. At that time, the substantive amount of the confined air can be more reduced as temperature of air is raised higher, however, in a case of using the thermosetting resin as the adhesive for the anisotropic conductive film 5, the temperature of the air is preferably set to less than or equal to the reaction temperature of the anisotropic conductive film 5, such as, e.g., temperature at which the thermosetting resin hardens. To be more precise, the temperature of air is preferably set at more than or equal to 60 degrees Celsius and more preferably, in a range between 90 and 159 degrees Celsius defined as the reaction temperature of the anisotropic conductive film 5.

[0024]

Next, the flexible board 1 bonded with the anisotropic conductive film 5 is desirably cooled down once. The volume of air confined below the anisotropic conductive film 5 is, as shown in Fig. 3D, reduced by cooling down the flexible board 1, thereby suppressing occurrence of the voids more certainly.

[0025]

The electronic component 3 is arranged at a prescribed position so that a surface of the electronic component 3 on which the bumps 4 are formed faces the anisotropic conductive film 5, and the arranged electronic component 3 is thermally bonded with application of heat. Therefore, the bumps 4 of the electronic component 3 are electronically connected to the wiring patterns 2 through the conductive particles in the anisotropic conductive film 5, thereby completing the electronic component mounting module.

[0026]

In the process of bonding the anisotropic conductive film 5 to the flexible board 1, the air is inevitably confined among concavities and convexities ascribable to the flexible board 1 in a concavo-convex form, however, according to this invention, the air intervening between the anisotropic conductive film 5 and the flexible board 1 is heated to keep the confined air expanded. That is, the substantive amount of air confined between the anisotropic conductive film 5 and the flexible board 1 is

previously reduced. Therefore, production of the voids, destruction of the anisotropic conductive film 5, or the like due to the confined air expansion is suppressed even where the air is heated again in the process of thermally bonding the electronic component. Cons equently, according to this invention, the electronic component mounting module having reliability can be manufactured, with which problems are avoided, such as, e.g., occurrence of voids, exposure of the wiring, or the like ascribable to the confined air. Furthermore, the electronic component mounting module having extremely high reliability can be manufactured without a process for forming ventilation holes on the flexible board 1.

Embodiments

[0027]

Specific embodiments with application of this invention are explained based on experimental results.

<First Embodiment>

[0028]

In this embodiment, the electronic component mounting module was manufactured using the anisotropic conductive films respectively having relatively low flowability (ACF-1: high viscosity), medium flowability (ACF-2: medium viscosity), and high flowability (ACF: low viscosity).

[0029]

The flexible board provided with the wiring patterns was first prepared and formed with the solder resist in a manner to surround the area to be mounted with the IC chip.

[0030]

The anisotropic conductive film was next bonded so as to coat the opening of the solder resist in a state where the air on the flexible board was heated up to 40 degrees Celsius by heating up the flexible board. Us ed as the anisotropic conductive film herein was the ACF-1 having a melt viscosity (at 100 degrees Celsius) of 2.5×107mPa·s, according to measurement in using a Haake RS150 rheometer manufactured by HAKKE Co., Ltd. The one or more IC chips were next aligned at a prescribed position on the anisotropic conductive film and subsequently heated and pressed to be mounted on the flexible board, thereby obtaining the electronic

component mounting module.

[0031]

Furthermore, the electronic component mounting module was manufactured in the same manner except that used as he anisotropic conductive film herein was the ACF-2 having a melt viscosity (at 100 degrees Celsius) of 1.1×107mPa·s, according to measurement in using the Haake RS150 rheometer manufactured by HAKKE Co., Ltd.

[0032]

Furthermore, the electronic component mounting module was manufactured in the same manner except that used as he anisotropic conductive film herein was the ACF-3 having a melt viscosity (at 100 degrees Celsius) of 4.0×106mPa·s, according to measurement in using the Haake RS150 rheometer manufactured by HAKKE Co., Ltd.

<Second Embodiment>

[0033]

The electronic component mounting module was manufactured using above described three kinds of the anisotropic conductive films in the same manner as in First Embodiment, except that the anisotropic conductive film was bonded so as to coat the opening of the solder resist in a state where the air on the flexible board was heated up to 60 degrees Celsius.

<Third Embodiment>

[0034]

The electronic component mounting module was manufactured using above described three kinds of the anisotropic conductive films in the same manner as in First Embodiment, except that the anisotropic conductive film was bonded so as to coat the opening of the solder resist in a state where the air on the flexible board was heated up to 80 degrees Celsius.

<Fourth Embodiment>

[0035]

The electronic component mounting module was manufactured using above described three kinds of the anisotropic conductive films in the same manner as in First Embodiment, except that the anisotropic conductive film was bonded so as to coat the opening of the solder resist in a state where the air on the flexible board was heated up

to 120 degrees Celsius.

<Comparative Example >

[0036]

In Comparative Example, the electronic component mounting module was manufactured using the anisotropic conductive films of the same kinds as those in each above embodiment, in the same manner as in the above described embodiments except that the air was not heated through the flexible board in a process for bonding the anisotropic conductive film. It is to be noted that in Comparative Example, the air between the flexible board and the anisotropic conductive film was at 25 degrees Celsius equal to room temperature.

[0037]

In regarding each of the thus manufactured electronic components, the area mounted with the IC chip was observed from a side of the flexible board to evaluate an generation status of the voids. Evaluation results are described in Table 1. It is to be noted that a variation basis for each of alphabetical notifications A to F in Table 1 is as shown in Fig. 4. That is, alphabetical notification A indicates a case of a void rate of less than or equal to 5 percent; alphabetical notification B indicates a case of a void rate of about 10 percent; alphabetical notification C indicates a case of a void rate of about 20 percent; alphabetical notification D indicates a case of a void rate of about 40 percent; alphabetical notification E indicates a case of a void rate of about 60 percent; and alphabetical notification F indicates a case of a void rate of more than or equal to 5 percent.

Table 1

Item	Comparative Example	First Embodiment	Second Embodiment	Third Embodiment	Fourth Embodiment
Heating Temperature	25degrees C.	40degrees C.	60degrees C.	80degrees C.	120degrees C.
ACF-1	F	F	E	D	B
SCF-2	E	E	D	C	B
ACF-3	C	B	A	A	A

[0038]

As is obvious from Table 1, improvement was observed in occurrence of the voids in each of Embodiments in which the air was heated during a process for

bonding the anisotropic conductive film, compared to Comparative Example in which the air was not heated. Especially in Second to Fourth Embodiments in which the air heating temperature is at more than or equal to 60 degrees Celsius, the void rate of less than or equal to 5 percent was achieved in a case of using the anisotropic conductive film ACF-3 and such improvement was obviously observed in using the other anisotropic conductive films ACF-1, ACF-2.

[0039]

It became clear from the above results that the amount of air confined between the anisotropic conductive film and the flexible board is decreased upon heating the air in a process for bonding the anisotropic conductive film, thereby being able to suppress the voids from occurring.

[0040]

As described above in detail, according to a method for mounting the electronic component in this invention, since the amount of air confined between the adhesive sheet and the printed board can be substantially decreased by heating the air in a process for bonding the adhesive sheet, the electronic component mounting module having high reliability can be manufactured, with which occurrence of voids, exposure of the wiring pattern, or the like is avoided.